

UCRL-JC-125413 Abs

Features of plasma produced by excimer laser at low intensities

A.Ya.Faenov, I.Yu.Skobelev, V.M.Dyakin, A.I. Magunov, T.A. Pikuz
MISDC of VNIIFTRI, Mendeleevo, Moscow region, 141570 Russia

G.A. Vergunova
P.N. Lebedev, Physical Institute of RAS, Leninskiy Prospect 53,
Moscow, Russia

A.L.Osterheld, W.H.Goldstein
Lawrence Livermore National Laboratories, Livermore, CA 94550

F.Flora, P.Di.Lazzaro, S.Bollanti, N.Lizi, T.Letardi
ENEA,INN.Fis. P.O. Box 65, 00044, Frascati (RM) Italy

A.Reale, L.Palladino
Dip. Fisica Universita dell'Aquila e INFN, g.c.LNGS, L'Aquila, Italy

D.Batani, S.Bossi, A. Bernardinello
Dip. Fisica Universita di Milano e INFN, Sezione di Milano, Italy

A.Scafati, L.Reale
Lab. Fisica, Istituto Superiore di Sanita e INFN, Sezione Sanita, Rome Italy

Investigations of radiative properties of plasma with moderate electron temperatures (T_e about 50–200 eV) and high densities (N_e about 10^{21} – 10^{22} cm $^{-3}$) are essential for many applications, such as inertial confinement fusion or x-ray lasers. In this report, such a plasma was created by the interaction of a 12 ns, short wavelength XeCl excimer laser with flat targets at laser flux densities of 4 – 8×10^{12} W/cm 2 , and studied by various x-ray spectroscopic methods. Spectral lines of H-, He- and Li-like ions of Na, Mg, and Al were obtained with spatial resolution. Shapes and intensities of these lines were compared to model calculations to determine the spatial distribution of the plasma parameters up to a distance of 0.4 mm from the target surface. A numerical simulation of the laser-target interaction was performed by means of a one dimensional gas-dynamic code taking into account laser bremsstrahlung, two-temperature gas-dynamics, energy transfer by electron heat conduction, and the self-radiation of the plasma in a multigroup approximation. The comparison of the experimental results with the theoretical modeling shows that the absorption of short-wavelength laser radiation in a plasma (at these laser flux densities) occurs by inverse bremsstrahlung in the region with $N_e < N_{e-crit}$. Spectra of Ne-like Ni XIX (with transitions $n1-2l'$ for $n=4$ – 15) have been also obtained in such plasma. The wavelengths of Rydberg series were measured with an accuracy 0.5–2.5 mÅ and were used to determine the first two ground state ionization energies of Ni XIX. Effects of configuration interaction were observed in the intensities of the spectral lines.

Work performed in part under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract W-7405-ENG-48.